



State of CERES



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CERES Science Team Meeting, April 26-28, 2022
Virtual Meeting

CERES Science Team Meeting

- Review status of CERES Instruments and Data Products
- Invited Presentations Session. Each presentation is 45 min including time for questions.
- Contributed Science Reports. Each report is 20 min including time for questions.

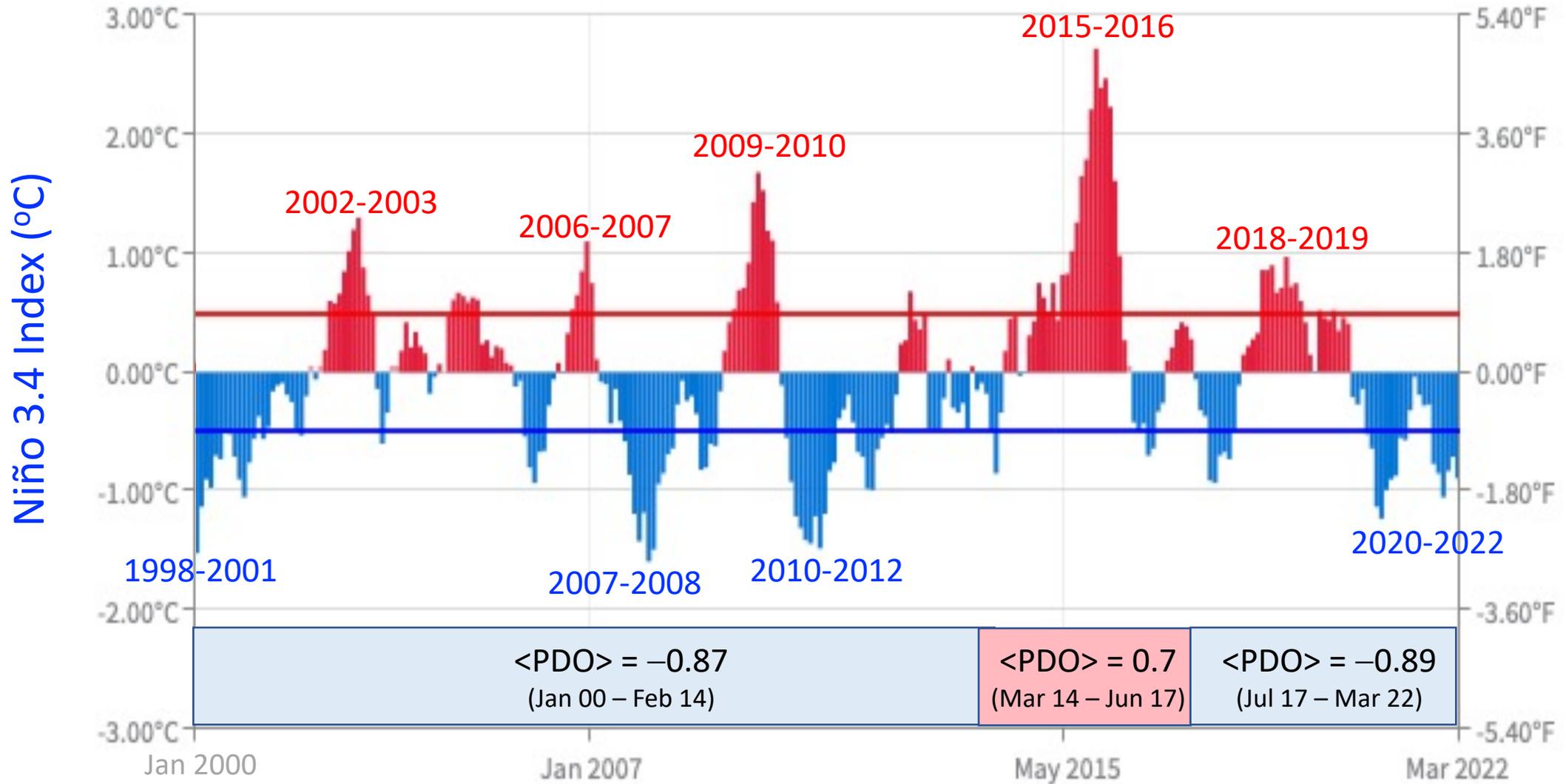
Please send an electronic copy of your presentation to Ed Kizer (edward.a.kizer@nasa.gov) at least one day prior to your presentation

CERES Technical Meeting

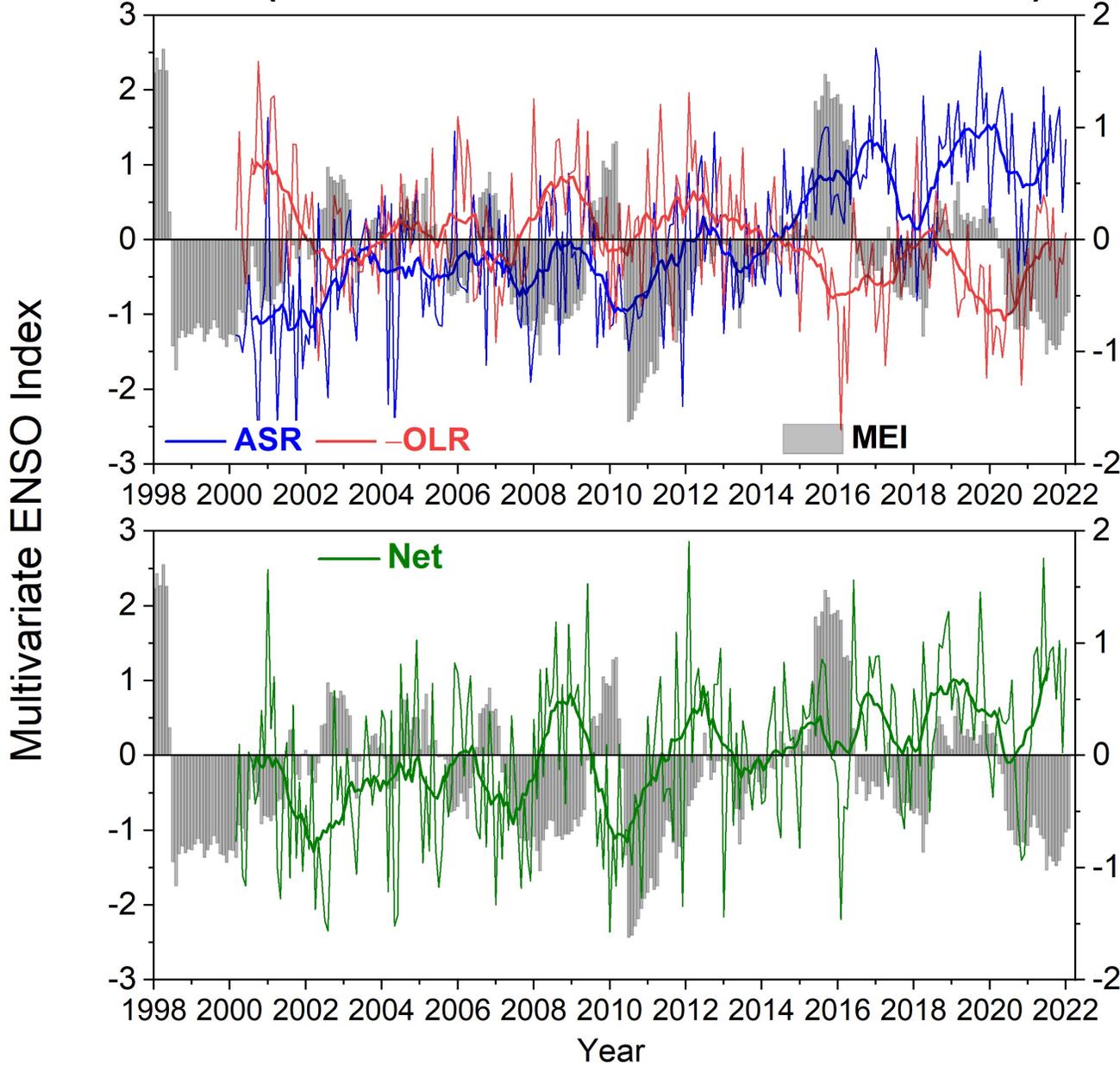
Review Status of CERES Instruments and Data Products:

- State of CERES
- CERES Terra, Aqua, S-NPP, NOAA-20 Instrument Calibration Update
- MODIS & VIIRS Cloud Algorithm & Validation Status
- ADM, SARB and TISA Working Group Reports
- EBAF Update
- FLASHFlux Update
- Data Management Team Update

Niño 3.4 Index (ONI) Anomaly & PDO Index (01/2000 – 03/2022)



Global Mean All-Sky TOA Flux Anomalies & Multivariate ENSO Index (CERES EBAF Ed4.1; 03/2000 – 01/2022)



EBAF Trends (03/2000-01/2022)

ASR: 0.69 ± 0.20 Wm⁻² per decade

LW: -0.27 ± 0.21 Wm⁻² per decade

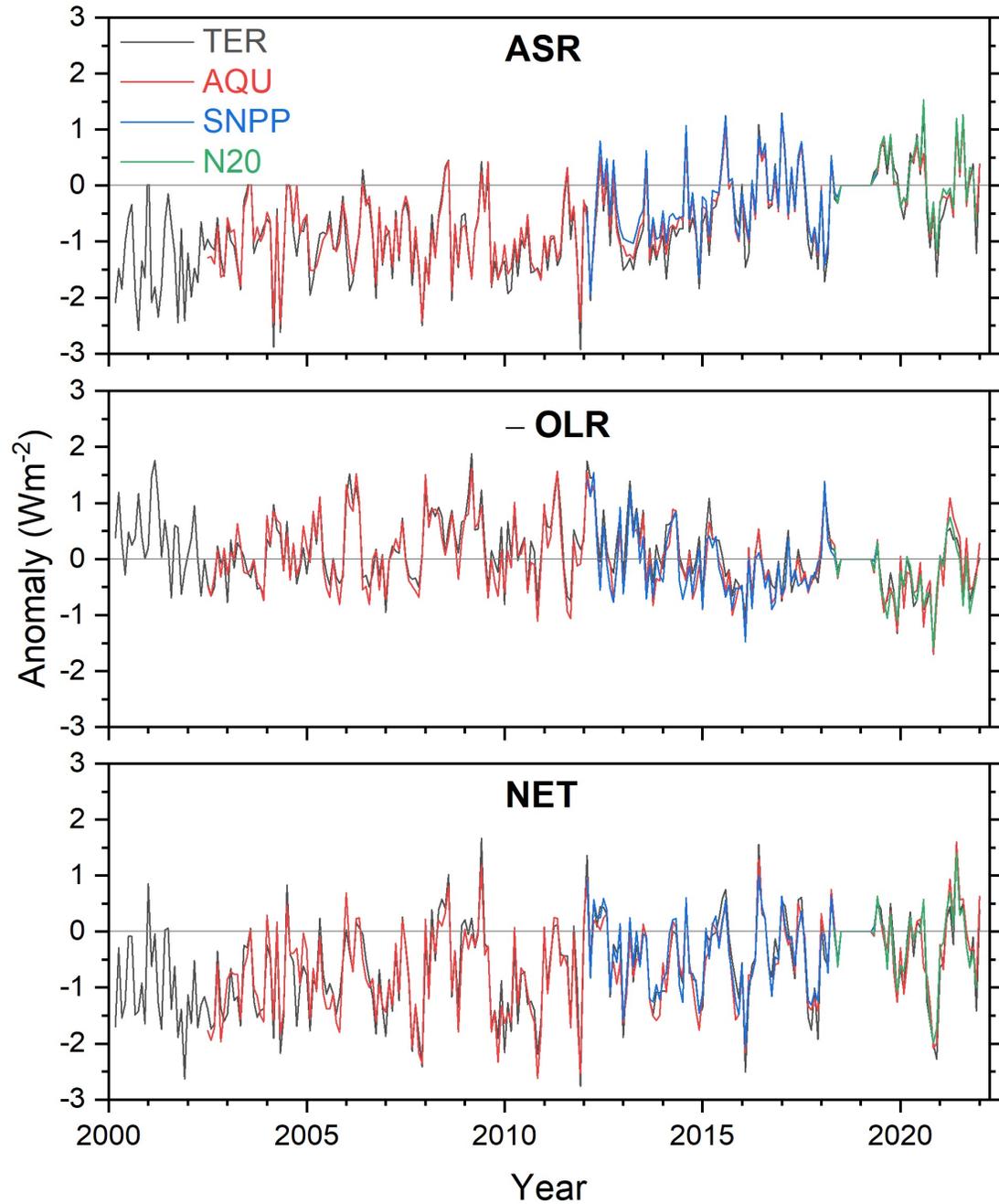
NET: 0.42 ± 0.20 Wm⁻² per decade

EI Changes: First and Last 5 years

- **EI (03/2000—02/2005): 0.44 Wm⁻²**
- **EI (02/2017—01/2022): 1.14 Wm⁻²**
- **Δ EI: 0.7 Wm⁻²**

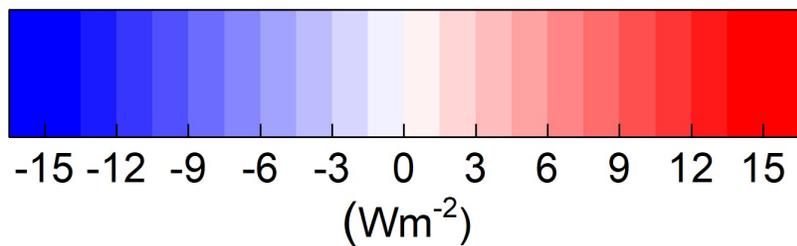
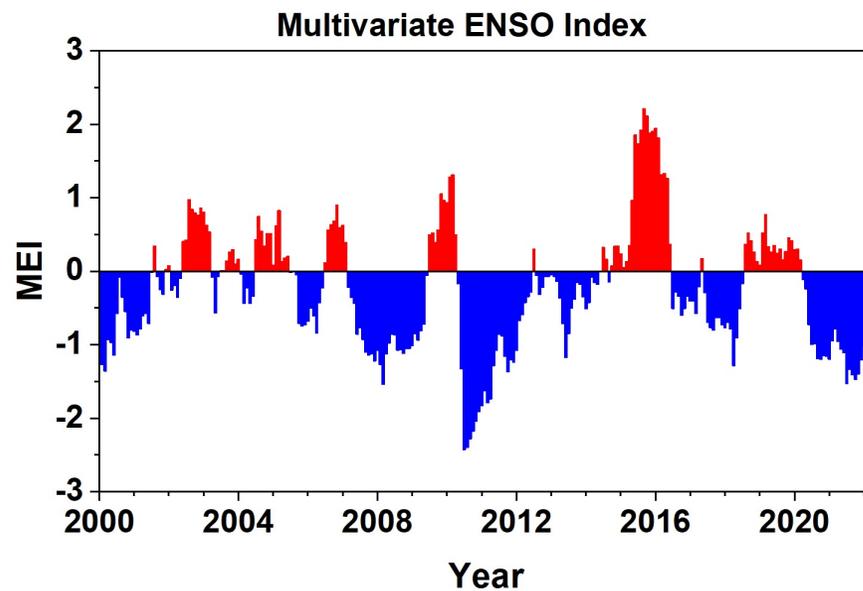
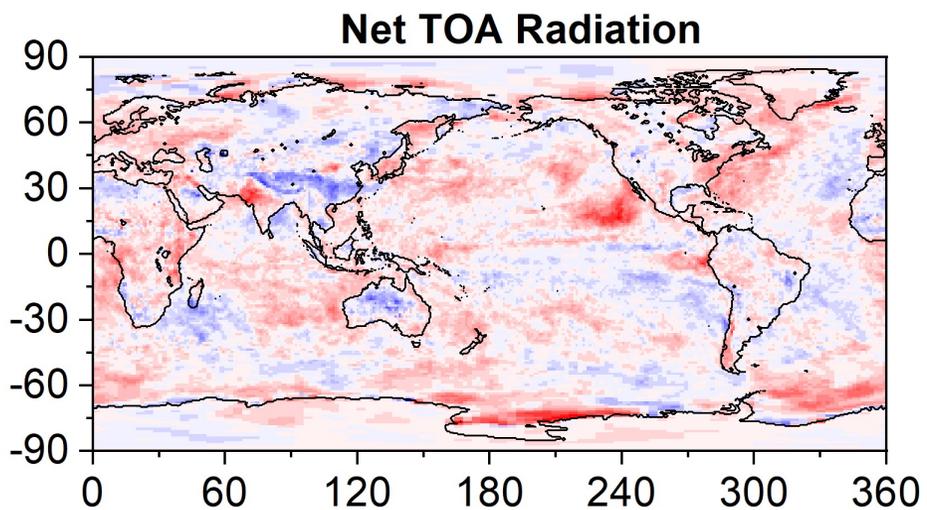
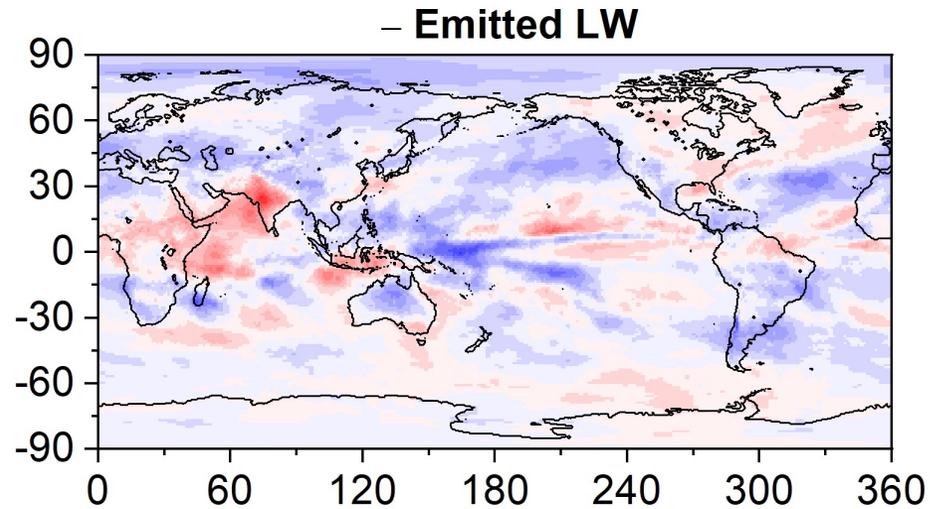
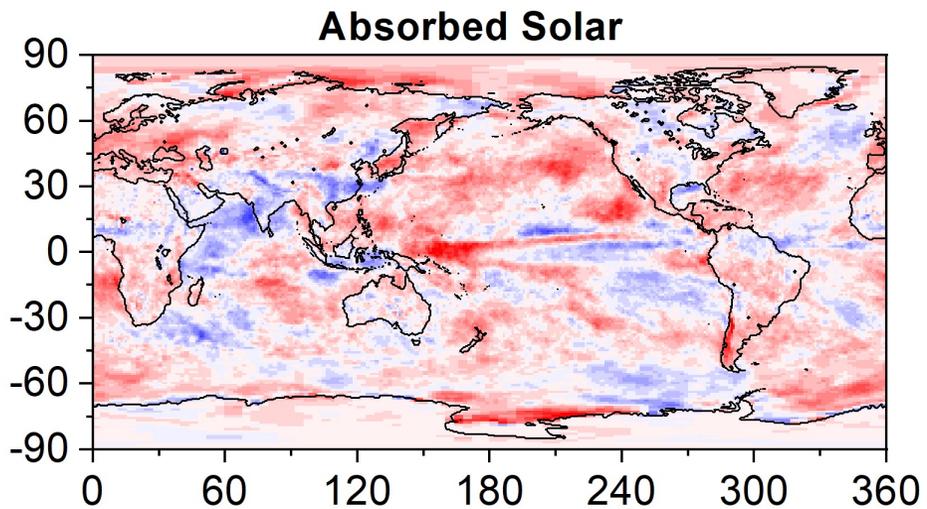
=> Approximate doubling of EI

Global Mean All-Sky TOA Flux Monthly Anomalies (03/2000-01/2022; Climatology: 05/2018—06/2019)

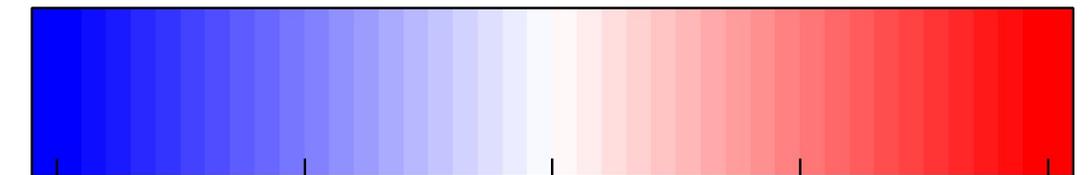
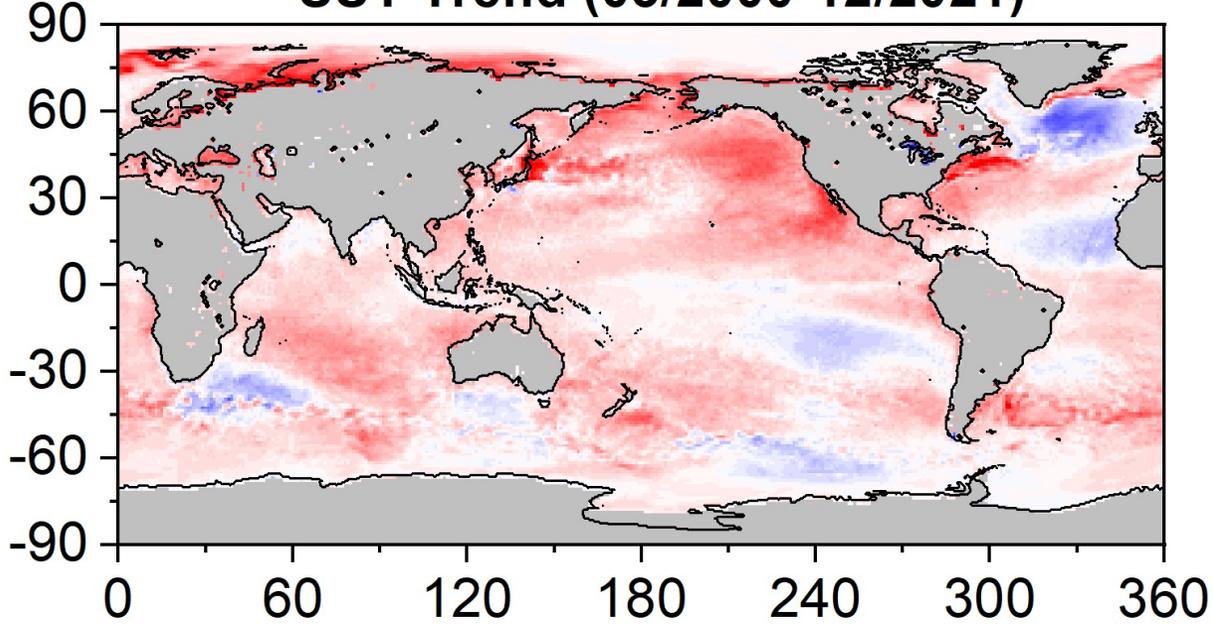


- Based upon CERES SSF1deg products (no GEO)
- NET monthly anomalies consistent to 0.3 Wm⁻² (1 σ)
- No evidence of CERES instrument drift

TOA Radiation Changes (03/2000 – 01/2022)



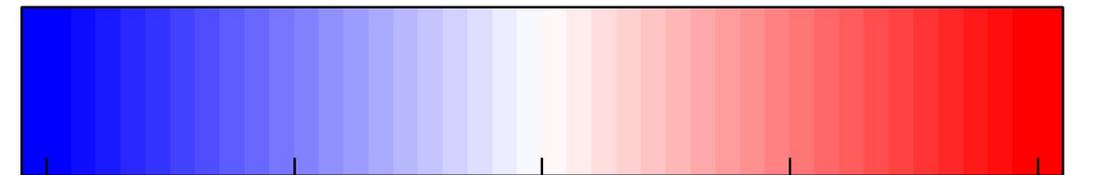
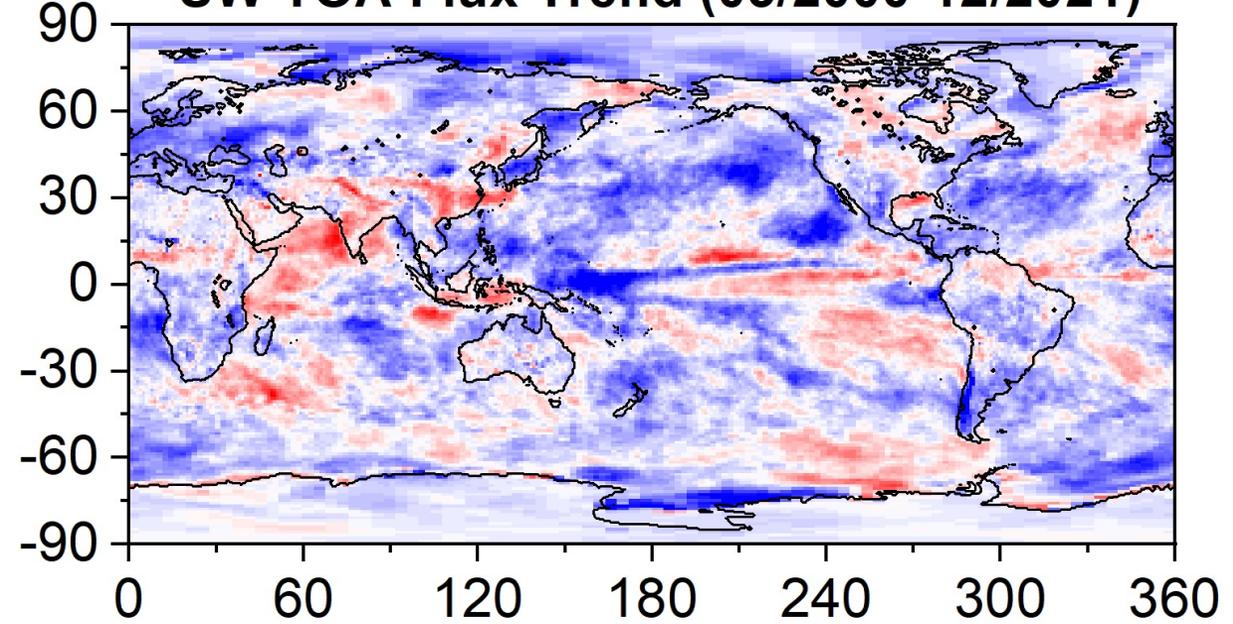
SST Trend (03/2000-12/2021)



-1.0 -0.5 0.0 0.5 1.0

(K dec⁻¹)

SW TOA Flux Trend (03/2000-12/2021)

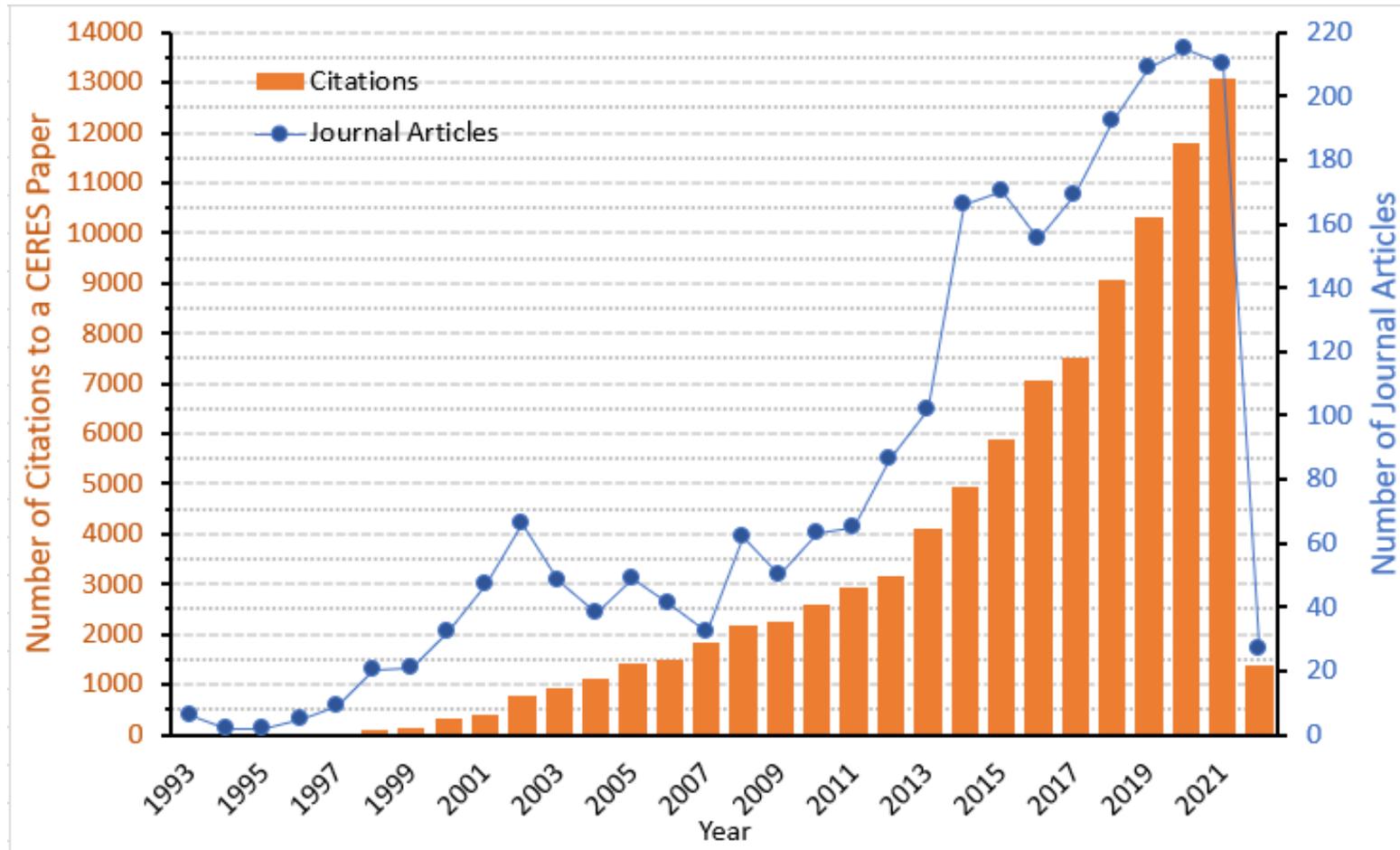


-5.0 -2.5 0.0 2.5 5.0

(Wm⁻² dec⁻¹)

- SST trend shows strong warming over Northern Hemisphere Eastern Pacific Ocean
- Northeast Pacific experienced marine heatwaves (“blobs”) in 2013-2015 and 2019-2020
- SW TOA flux trend pattern is closely linked to SST trend pattern (especially in regions with abundant low cloud)

CERES Journal Publications and Citation Counts (For Papers Between 1993-2022; Updated March 8, 2022)



- Total number of peer-reviewed journal articles: 2,359
- Total number of citations to CERES papers: 96,853

(Compiled by Dennis Keyes)

Number of Unique Users by CERES Data Product (through March 31, 2022)

Level	Product	2013	2014	2015	2016	2017	2018	2019	2020	2021*	2022*
1b	BDS	19	14	11	13	14	10	12	19	5	0
2	SSF	223	247	253	278	327	235	251	229	209	74
	FLASH_SSF	23	30	61	41	68	101	92	97	85	38
	CCCM	37	28	55	54	49	49	36	37	35	1
	ES8	31	16	21	15	15	10	8	8	0	0
	SSF-MISR	5	4	2	1	3	1	1	4	3	0
3 & 3b	EBAF	602	731	787	783	935	928	995	1010	921	310
	SYN1deg	353	382	438	494	607	639	754	827	765	285
	SSF1deg	157	166	160	194	190	159	221	199	185	52
	CldTypHist	57	41	40	47	86	87	79	84	74	20
	FluxByCldTyp								44	56	12
	ES4	27	19	13	12	17	17	17	10	5	0
	ES9	13	9	5	5	8	6	6	3	2	0
	FLASH_TISA	17	15	15	36	52	65	81	127	103	29

FLASHFlux via POWER since last year: **105,702**

* The numbers are lower because most orders through ASDC now come from Direct Data Download, which are not currently captured in the ESDIS Metrics System (EMS), although they are working on it.

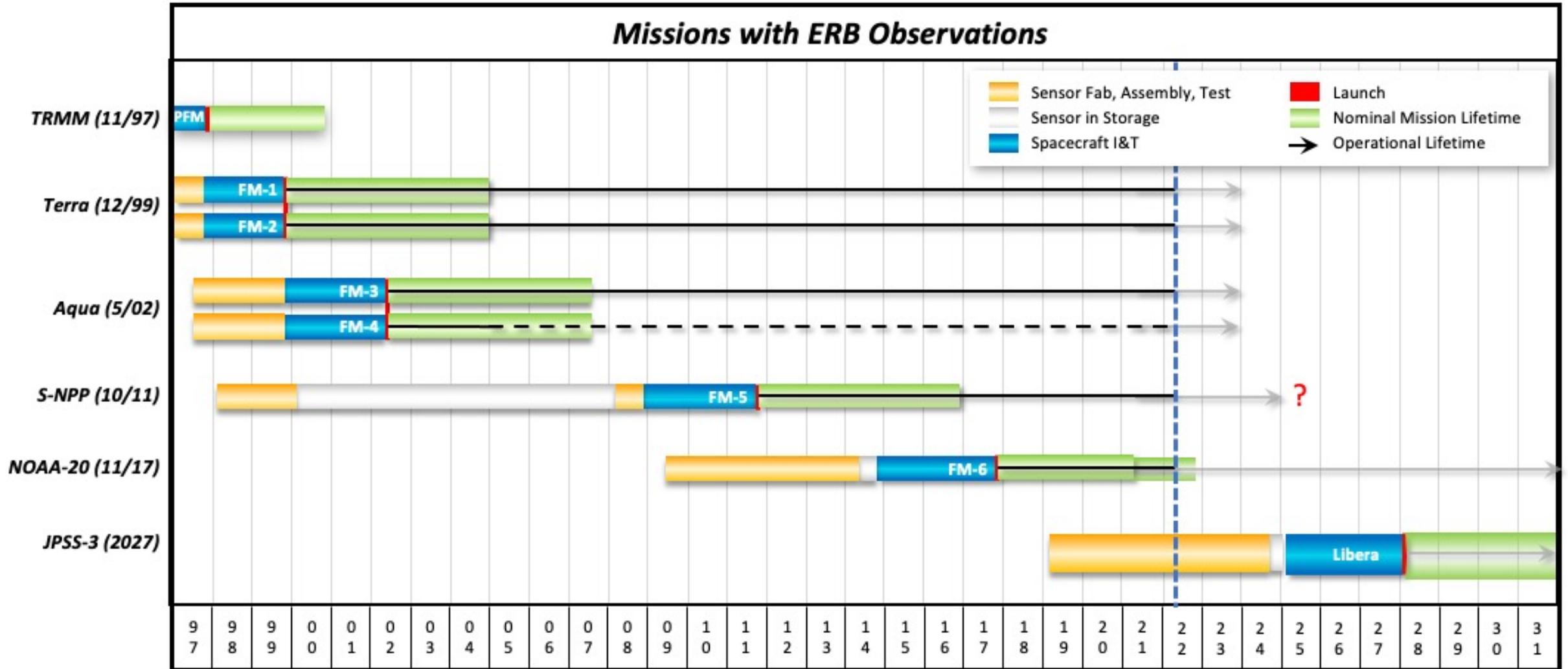
Aqua Status

- March 31, 2022: Fault in primary Power Controller (PC-A) was detected. Swap to redundant PC-B was automatically made.
- Spacecraft was put into Earth Point Safe Mode
- Root cause: Likely a solar weather event while the Aqua was passing through the South Atlantic Anomaly, leading to one or more bit flips.
- Current Status: Aqua fully recovered and brought out of safe mode on April 14. FM3 and FM4 were brought out of safe mode April 15 and are nominal.

Future Operations of Terra, Aqua and S-NPP

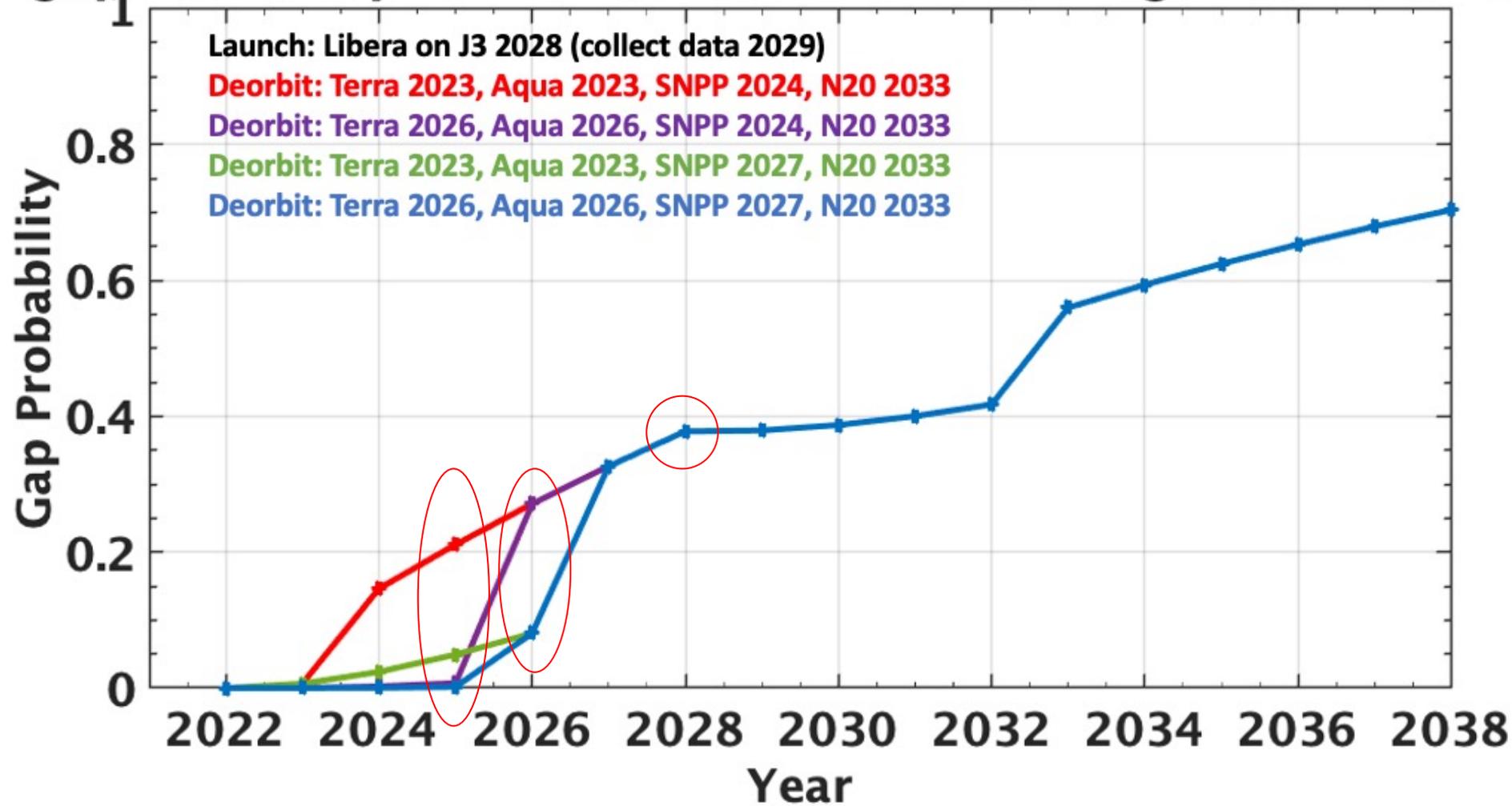
- President's in-guide budget for Terra, Aqua and Aura ends science data collection in 2023, even though the missions can last at least through 2026 (Terra & Aqua), albeit with a drifting MLT.
- Aqua, Terra and Aura Projects are investigating alternate scenarios that might enable the missions to continue operating beyond 2023 (e.g., cost savings) should there be an opportunity.
- S-NPP (launched in 2011), will continue to operate at least through spring 2024, 1.5 years after JPSS-2 launches in September 2022.
 - S-NPP can last at least through 2027 based upon available consumables.
- If S-NPP ends science data collection in 2024, that will leave only CERES FM6 (NOAA-20, L2017), to provide overlap with Libera, scheduled for launch in 2028.

Flight Schedules



- Currently, 6 CERES instruments fly on 4 satellites: Terra (L1999), Aqua (L2002), SNPP(L2011), NOAA-20 (L2017)
- Libera scheduled for launch in 2027 on JPSS-3

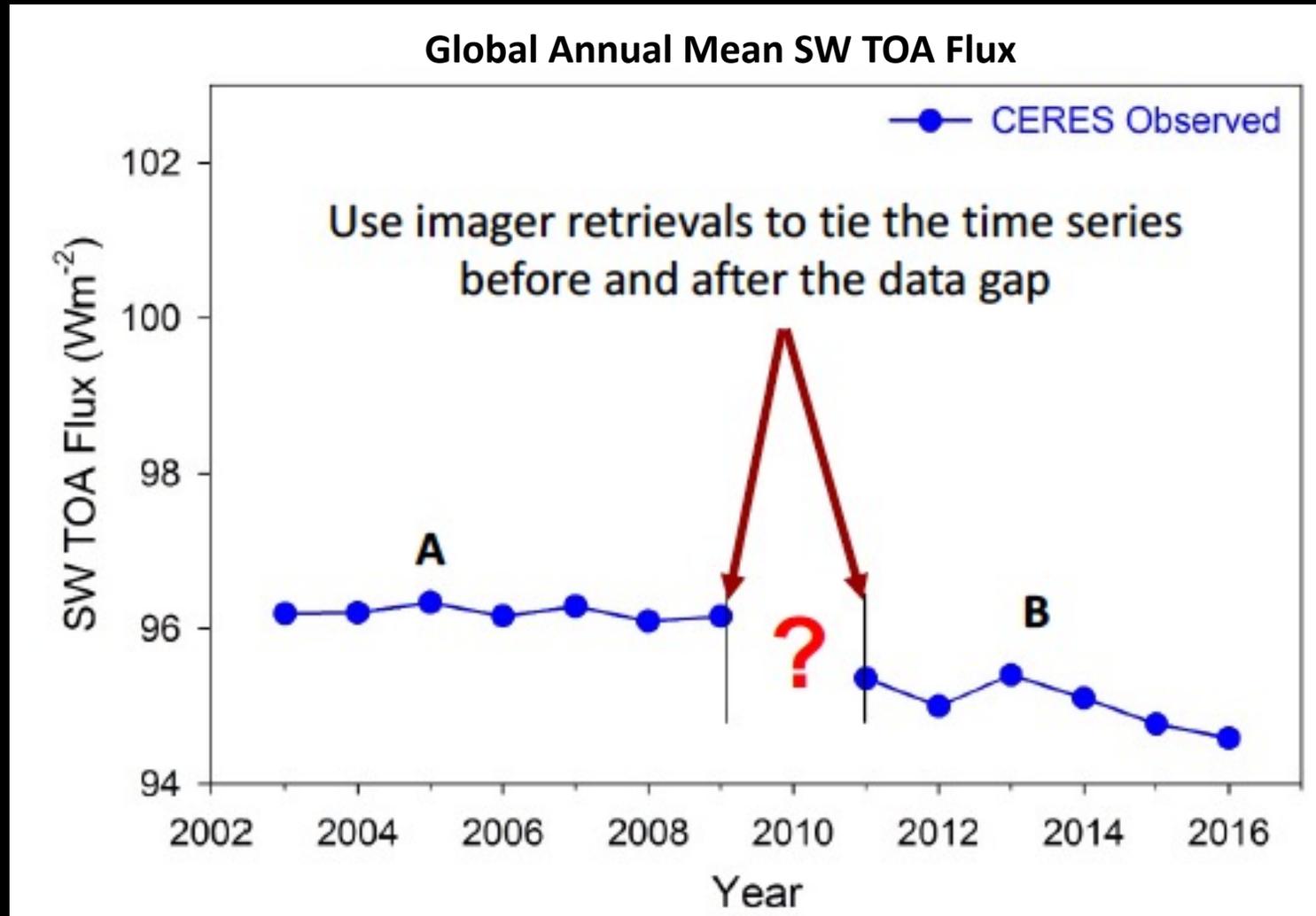
gap₁ risk analysis with constant CERES/imager survival rate



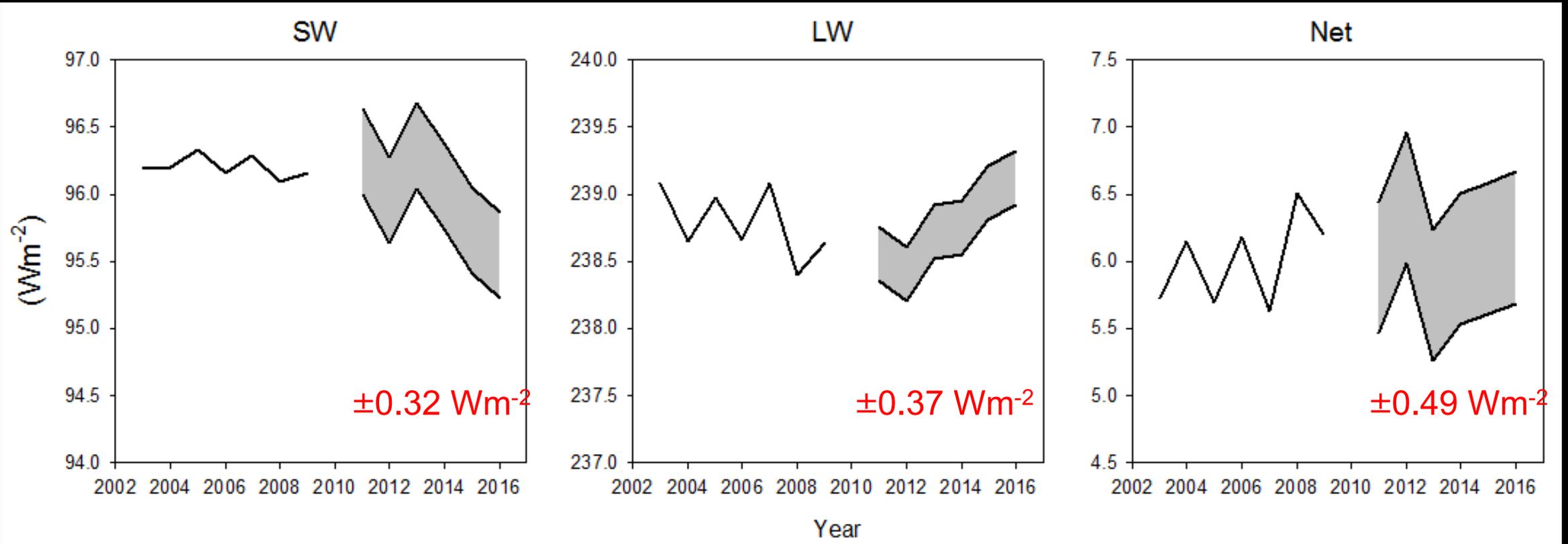
- Gap risk in 2025 exceeds 20% if SNPP ends in 2024 and TER & AQU end in 2023. Remains <5% if either SNPP ends in 2027 or TER & AQU end in 2026.
- Gap risk in 2026 reaches 27% if SNPP ends in 2024 but remains <10% if SNPP ends in 2027.
- Gap risk reaches 38% when Libera launches in 2028 for all scenarios.

Bridging a Data Gap in the ERB CDR

Goal: Examine the feasibility of using less-accurate imager retrievals to compute radiative fluxes and tie the time series before and after a data gap together.



Bridging a Data Gap in the ERB CDR



- Assumes imager remains healthy and perfectly stable across the data gap. The longer the gap, the greater the risk.
- The resulting uncertainty is too large to enable decade-to-decade changes in EEI to be resolved.
- Time to detect a real trend above uncertainty would increase substantially.
- A gap would require considerable extra post-processing effort, thereby delaying release of the ERB data products.

Planning for Terra & Aqua Edition 5

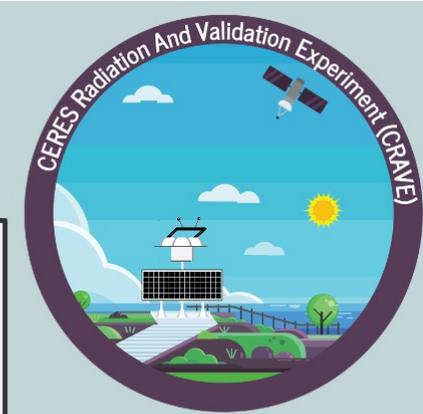
Main Considerations:

- 1) GMAO improvements to their atmospheric reanalysis system.
 - CERES and GMAO hold WebEx meetings every 3 weeks to gauge progress and provide ongoing validation results for the latest GEOS FP or FPIT version.
- 2) MODIS Collection 7 schedule.
- 4) CERES production code improvements.
- 5) CERES algorithm improvements (particularly those enabling a seamless transition across satellite platforms).

Note: EBAF Ed4.2 will be released this year in order transition from Terra+Aqua to NOAA-20 and to mitigate discontinuities in EBAF-SFC associated with input reanalysis data and GEO artifacts.

CRAVE – CERES Radiation and Validation Experiments

<https://science.larc.nasa.gov/CRAVE/>



tracker 2022-01-10 13:14:15 LST



GRANITE ISLAND

- Data was humming along until early January 2022, when a severe ice/snow storm caused solar tracker failure.
- Then, in late January, the batteries failed due to lack of charging (No sun for weeks). The island's power system was also strained, first time in 5 years.
- New batteries are "on order" to bring the site back online. An agreement has been made with the owner of the island to draw power from the island's generator system. This should prevent any future power failures due to lack of sun.
- The site is expected to become operational again on our next visit (May/June).
- Current data availability is 2018 July - 2022 January.

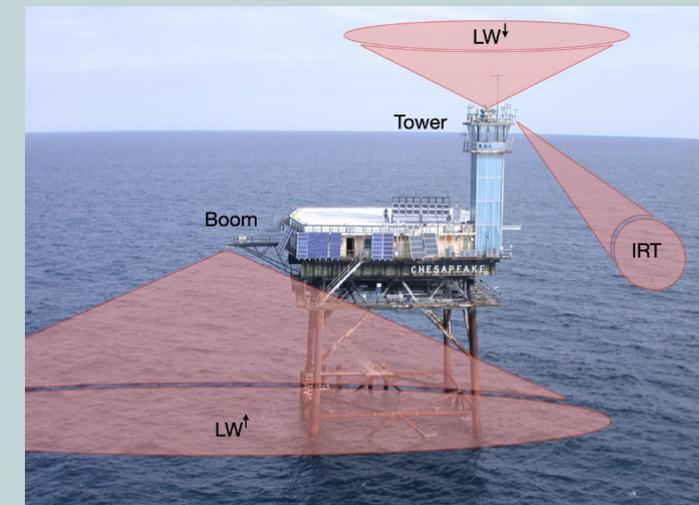


LaRC

- Everything is working well.
- Added PAR instrument.
- New Vaisala weather station installed (Hardware provided by Margaret Pippin).
- New control system for the reference absolute cavity pyrhelimeters, used for shortwave calibrations, is currently being tested to replace 15+ year system.
- Current data availability is 2014 December - 2022 March.

COVE (Legacy)

- Data availability from 2000 May - 2016 November.
- Paper on the Upwelling Longwave Tower Effect is progressing.



Upcoming Conferences & Meetings of Interest

Sun-Climate Symposium

- May 16-20, 2022, Madison, WI

International Radiation Symposium (IRS)

- July 4-8, 2022, Thessaloniki, Greece.

AMS 16th Conference on Cloud Physics & Atmospheric Radiation

- August 8-12, 2022, Madison, WI.

Fall 2022 ERB Workshop (CERES/Libera/GERB/ScaRaB)+Science

- October 12-14, 2022, Hamburg, Germany.

Fall AGU

- December 12-16, 2022, Chicago, IL